MODESTUM
OPEN ACCESS

EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(7), 3293-3300
ISSN:1305-8223 (online) 1305-8215 (print)
**Research Paper** https://doi.org/10.29333/ejmste/91245

# Effects of the Application of Computer Multimedia Teaching to Automobile Vocational Education on Students' Learning Satisfaction and Learning Outcome

Yu-Feng Chen [1], Yu-Zhou Luo [2*], Xu Fang [3], Chich-Jen Shieh [1]

[1] School of Electrical and Information Engineering, Hubei University of Automotive Technology, Shiyan, CHINA
[2] School of Medical Instruments, Shanghai University of Medicine & Health Sciences, Shanghai, CHINA
[3] Planning Development Branch, University of Shanghai for Science and Technology, Shanghai, CHINA

Received 24 January 2018 ▪ Revised 29 March 2018 ▪ Accepted 8 May 2018

**ABSTRACT**

Along with the change in computer technology, the application of multimedia assisted teaching to education and research plays a critical role with the popularity of computer technology and the diverse development. Multimedia assisted teaching materials could assist teachers in teaching as well as enhance students' autonomous learning that computer multimedia teaching has become an alternative teaching tool beyond traditional learning. With quasi-experimental study, 216 students in the automobile applied technology opened by a vocational college in Shanghai, are proceeded 16-week (3 hours per week for total 48 hours) experimental teaching. The research results show positive relations between 1.virtual reality technology and learning satisfaction, 2.virtual reality technology and learning outcome, and 3.learning satisfaction and learning outcome. According to the results, suggestions are proposed, expecting to provide automobile vocational education students with the situation close to real life acquiring required skills, knowledge, or behavior through learning processes to cultivate the automobile service talents with comprehensive technology.

**Keywords:** virtual reality technology, vocational education, learning satisfaction, learning outcome

## INTRODUCTION

The application of multimedia assisted teaching to education and research plays a primary role with the changing computer technology. Multimedia assisted teaching materials could assist teachers in the teaching and enhance the autonomous learning of students who could constantly and repeatedly review and practice unfamiliar contents to achieve the mastery learning. For this reason, computer multimedia teaching is constantly promoted; the popularity and multiple development of computer technology rely on the function of multimedia. In this case, teaching and multimedia also present critical effects. "Computer multimedia teaching" therefore becomes the traditional learning as well as a teaching assisted tool. In terms of education, computer multimedia teaching could effectively enhance teaching quality to break through the limits of time and space as well as receive immediate learning effect to assist in traditional teaching and have learners present multiple learning and innovation capability. The application of multimedia and the Internet as well as the development of new knowledge could manifest teaching quality.

Along with the development of network, intelligence, electronics, and information, automobile has been developed from transportation to exchange tools. The number of automobile in China reached 0.217 billion by 2017 which enhanced the rapid development of new-energy automobile and provide huge opportunities for automobile after-service markets. In the macro environment, automobile service industry proposes higher requirements for automobile service talents. In addition to grasping the knowledge of automobile internal structure, automobile


✉ chenyf_dy@huat.edu.cn ✉ luoyz@sumhs.edu.cn **(*Correspondence)** ✉ xufang@usst.edu.cn
✉ charleshieh@163.com

**Contribution of this paper to the literature**

- As the large effect of the interface design refinement of virtual reality materials on learning outcome, detailed revisions and suggestions could be acquired after several times of user tests to gradually refine the interface design and interaction operation.
- Teachers integrating virtual reality technology and changes into course design and present diversified teaching methods could assist in enhancing students' learning intention and further promote the learning outcome.
- Properly opening some departments for university-level education could enhance the technical profession of vocational graduates. Besides, industry-university cooperation for students' internship or the opening of industry-university cooperation classes could conform to the requirements of local industries and allow students studying for the purpose of application to engage in relevant industries after the graduation.

service talents have to grasp automobile maintenance knowledge and follow the development of maintenance equipment, especially adequate knowledge reserve, to conform to the requirements for the motorized, intellectual, and networking development trend of automobile. In this case, it is necessary to cultivate automobile service talents with comprehensive techniques and stronger practice capability. This study therefore focuses on the effect of applying computer multimedia education to automobile vocational education on students' learning satisfaction and learning effectiveness. It is expected to enhance automobile vocational students' required skills, knowledge, or behaviors in the learning situation created with computer multimedia education close to real environment to cultivate automobile service talents with comprehensive techniques.

# LITERATURE AND HYPOTHESIS

## Computer Multimedia Teaching

Ab Aziz and Siang (2014) pointed out multimedia as being able to process texts and media of graphics, images, audio, animation, or video under the same working environment through the integration of computers (Lan et al., 2015). It implied to the program presentation with the combination of two or more than two different media to present static and dynamic sound and light effects (Maruping, Bala, Venkatesh, & Brown, 2017). Freina and Ott (2015) explained that "multimedia" did not simply present single message diversely but could complementarily apply various types of media to have the integrated effect exceed the independent application of media. Lan et al. (2015) referred it as an education concept as well as the teaching process directly applying computer communication model to present teaching materials and control individualized learning environment (Lan, 2015). The characteristics of image and audio integrated by interactive computer multimedia teaching with communication and media technology have diverse and open learning environment further enhance the role of computer multimedia assisted teaching technology in educational reform (Lan et al., 2015). Traditional computer multimedia assisted teaching is limited to drawing ability and merely transmitting meanings with texts or simple graphs to result in teaching outcomes being hard to break through and enhance. Since the emergence of computers and recorders, traditional computer multimedia assisted teaching could combine the sound and light effect of tape recorders with the process ability; and, multimedia computer assisted teaching systems combining computers with slide projectors and projectors also enhance computer multimedia assisted teaching entering the multimedia era (Lan, 2014).

Referring to Huang, Liaw, and Lai (2016), computer multimedia teaching used to be measured with law of effect, law of continuity, and law of practice.

(1) Law of effect: Instructors should provide proper feedback for learners' responses. Correct learning should provide positive reinforcement to develop encouragement function; on the contrary, negative reinforcement is provided for the suppression.

(2) Law of continuity: To enhance the function and develop the effect, feedback should present "immediateness", providing immediate feedback for learners' responses that the closer responses and feedback would result in larger effect.

(3) Law of practice: Instructors should provide opportunities for repeated practice till learners could provide correct answers in the shortest time to achieve the mastery.

## Vocational Education

Ali, Ullah, Alam, and Rafique (2014) pointed out different names for vocational education, such as "further education" or "technical education" in UK, "vocational training" in Germany, "industrial education" or "career

education" in the USA, "industrial education" and "production education" in Japan, and "polytechnic education" in Russia. Martins, Oliveira, and Popovič (2014) regarded it as a highly professional technical education, aiming to cultivate advanced professional talents of technicians and engineers. Griffin et al. (2017) regarded higher vocational education in China was the important composition of higher education, aiming to cultivate high-level technicians required for the economic society, especially being able to solve technical problems in the first-line production process. Being affected by globalization, technology is rapidly advanced that school education can no longer meet the requirements of industries. To cope with time change and global technology division, vocational education reform has been positively preceded in the world, such as integrating education and vocational training with employment department, completing vocational certificates close to employment market, revising vocational education regulations, and promoting industry-university cooperation (Kuksa & Childs, 2014), to cultivate cross-nation talents. Vocational education change requires the cultivation of students' key competency and, more important, inspires modernization capability for a modern person in the 21st century, which should be specially emphasized in all-level education.

## Learning Satisfaction

In learning courses, learners' desires and needs being satisfied and achieved in the learning process is regarded as learning satisfaction (Kim, Son, & Han, 2016). Wijnants, Van Erum, Quax, and Lamotte (2015) pointed out learning satisfaction as a major item to measure learning result; in addition to students, teachers, curricula, and learning environment were the factors in student satisfaction. Nawaz et al. (2014) regarded learning satisfaction as students being "satisfied" by feeling happy or presenting positive attitudes towards learning activity and "dissatisfied" by feeling unhappy or negative attitudes. Bhagat, Liou, and Chang (2016) considered learning satisfaction as students' good perception or positive attitudes generated by favoring the course in the participation in learning activity. Shen, Ho, Kuo, and Luong (2017) explained learning satisfaction as the perception or attitudes generated in involving in favorable learning processes to induce individual motivated learning, persistent learning, and positive learning attitudes to eventually satisfy individual needs and expectation. Shafer, Carbonara, and Popova (2014) regarded the interaction between internal subjective perception and external learning as learning satisfaction. Shi (2017) indicated learning satisfaction that learning was to enhance the interests in learning courses and positive learning attitudes towards learning activities to satisfy learners' perceived needs and individual learning needs in the learning process.

Referring to Shen et al. (2017), learning satisfaction contains teachers' teaching and curriculum & environment in this study.

(1) Teachers' teaching: Teachers' professional knowledge, methods to solve students' problems, preparation for courses, teaching methods, teaching attitudes, interaction with students, and understanding students' individual needs would assist in promoting students learning satisfaction.

(2) Curriculum & environment: Learners present interests on and enhance the positive attitudes towards the content and behavior of learning activity.

## Learning Outcome

A more persistent behavioral result through learning processes is regarded as learning outcome (Lan et al., 2015). Ratna and Mehra (2015) regarded learning outcome as the indicator to evaluate teaching and measure learners' learning result. Wei, Peng, and Chou (2015) proposed to measure with different indicators, including learning satisfaction, self-evaluation, learning interests, performance, and experience, as well as the learning behavior and learning results of the evaluation and participation in learning activities. Daggubati (2016) pointed out correct learning methods, good learning habits, and positive learning attitudes as the essential conditions to enhance students' learning efficiency. Wamba, Bhattacharya, Trinchera, and Ngai (2017) defined learning outcome as learners being able to change the professional knowledge and skills in the learning activity. Ryan (2015) regarded "skill" as the most important learning outcome that the better learning outcome, the better performance. Kourouthanassis, Boletsis, Bardaki, and Chasanidou (2015) indicated that learning outcome was the learning result, with direct and positive effects, presented on various evaluation and tests of learners after completing the learning process. Schuster et al. (2014) referred learning outcome to certain evaluation performance of learners after a period of learning activity. Kim et al. (2016) pointed out learning outcome as the expectation of what a learner learned, understood, and could describe after a period of learning processes. Lan, Kan, Sung, and Chang (2016) regarded learning outcome as learners' learning performance, including formative and summative evaluation results. Accordingly, learning outcome, referring to Lan et al. (2016), is measured with single dimensions, including test performance, schedule completion time, and term performance, in this study.

### Relationship between Computer Multimedia Teaching and Learner Satisfaction

Mütterlein and Hess (2017) pointed out computer multimedia teaching as teaching activities not being restricted to time and space, allowing learners actively receiving information and achieving learning goals at any time. Besides, multimedia assisted teaching integrated, systemized, and organized texts, pictures, video, images, and animation into computers to satisfy learners accepting visual and hearing information technology changes to effectively enhance learner satisfaction. Freina and Ott (2015) mentioned that multimedia assisted teaching was affected by the design principle of programmed teaching, leaner-centered, behavioral goal oriented, and presented contents step by step to achieve learner satisfaction with constantly repeated practice through stimulation responses and immediate reinforcement. Computer multimedia teaching could provide multiple sensory stimulation, attract children's attention through vivid pictures, text symbols, and sound, as well as enhance learning interests and deepen learning impression (Lan, 2015). Bhagat et al. (2016) described that computer multimedia teaching provided students with opportunities to self-grasp learning schedule and achieve learning satisfaction from feedback. From above literatures, the following hypothesis is inferred.

**H1:** Computer multimedia teaching presents positive correlations with learner satisfaction.

### Relationship between Computer Multimedia Teaching and Learning Outcome

Huang et al. (2016) regarded multimedia as an effective tool to fulfill situated teaching, develop stories with connection, and induce learner interests through careful design so that learners could reflect the learning process in the operation process and contact more accidental possibilities in the looping execution. Such teaching design normally could achieve the goals of cognition, affection, skills, and life education. Meanwhile, as the teaching is preceded through games, it could enhance learners' learning intention and learning outcome. Kourouthanassis et al. (2015) indicated that multimedia assisted learning courses should be integrated into relevant work to integrate knowledge into learning situations and have learners interact and actively participate in learning activities from observation, imitation, and learning as well as knowledge and skills to achieve learners' interactive relationship between simulated situational activities and learning situations (Lan et al., 2015). Daggubati (2016) concluded that multimedia assisted learning could induce students' learning motivation, fulfill learning initiative, and grasp the interaction with environment to achieve skill learning and effectively enhance learning outcome. Accordingly, the following hypothesis is inferred.

**H2:** Computer multimedia teaching shows positive correlations with learning outcome.

### Relationship between Learning Satisfaction and Learning Outcome

Shen et al. (2017) regarded various behaviors, attitudes, and perception of learning activity to present the preference of the learning activity as learning satisfaction; and, students with higher learning satisfaction would present better learning outcome, which therefore was a primary goal of distinct learning. Lan et al. (2016) discussed the relationship between learning satisfaction and learning outcome and revealed the remarkably positive effect of learning satisfaction on learning outcome. Juan and Chao (2015) found out the moderately positive correlation between learning satisfaction on learning outcome of students in PE classes in elementary schools in Taipei City and New Taipei City. Shi (2017) proved the notably positive correlations between students' learning satisfaction and learning outcome in swimming lessons. Jung and Han (2014) discussed G6 students in an elementary school and found out the significantly positive correlation between learning outcome and learning satisfaction. The following hypothesis is then inferred from above literatures.

**H3:** Learning satisfaction reveals significantly positive relations with learning outcome.

## SAMPLE AND MEASURING INDICATOR

### Research Sample and Object

Aiming at the automobile applied technology opened by a vocational college in Shanghai, 216 students are proceeded the 16-week (3 hours per week for total 48 hours) quasi-experiment. The retrieved data are analyzed with SPSS, and Regression Analysis and Analysis of Variance are applied to test various hypotheses.

### Reliability and Validity Test

Validity refers to a measuring tool being able to really measure what a researcher intends to measure. Generally speaking, validity is divided into content validity, criterion-related validity, and construct validity. The items used in the questionnaire are referred to domestic and international researchers' items, and a pretest is preceded before

**Table 1.** Analysis result of overall linear structural relation model

| Evaluation item | parameter/evaluation standard | | result | t |
|---|---|---|---|---|
| preliminary fit criteria | Computer multimedia teaching | law of effect | 0.713 | 12.16** |
| | | law of continuity | 0.708 | 10.33** |
| | | law of practice | 0.723 | 13.41** |
| | learning satisfaction | teachers' teaching | 0.744 | 15.27** |
| | | curriculum & environment | 0.756 | 16.12** |
| | learning outcome | | 0.769 | 18.44** |
| fit of internal structure of model | Computer multimedia teaching→learning satisfaction | | 0.863 | 33.91** |
| | Computer multimedia teaching→learning outcome | | 0.849 | 31.63** |
| | learning satisfaction→learning outcome | | 0.827 | 28.33** |
| overall model fit | X2/Df | | 1.177 | |
| | GFI | | 0.982 | |
| | AGFI | | 0.927 | |
| | RMR | | 0.007 | |

Note: * stands for p<0.05, ** for p<0.01, and *** for p<0.001

the distribution of formal questionnaire that the questionnaire presents certain content validity. Virtual reality technology, learning satisfaction, and learning outcome are tested the causal relationship with Linear Structural Relations, and the data registration is based on the correlation coefficient matrix of above observed variables. The analysis result with Linear Structural Relations Model shows the overall model fit reaching the reasonable range that it presents favorable convergent validity and predictive validity. Item-to-total correlation coefficients are used for testing the construct validity of the questionnaire, i.e. reliability analysis, and the acquired item-to-total correlation coefficients are applied to judge the questionnaire content. The item-to-total correlation coefficients of the dimensions are higher than 0.7, revealing certain construct validity of the questionnaire.

To further understand the reliability and validity of the questionnaire, reliability and validity analyses are further preceded. The higher Cronbach's α presents the better reliability. The formal questionnaire is developed according to the standards, and the measured Cronbach's α appears in 0.70~0.88, obviously conforming to the reliability range.

# EMPIRICAL RESULT ANALYSIS

## LISREL Model Indicator

LISREL (linear structural relation) model, combining factor analysis and path analysis in traditional statistics and adding simultaneous equation in econometrics, is the research tool being able to simultaneously calculate multi-factor and multi-casual path. The goodness-of-fit of the model could be evaluated from preliminary fit criteria, overall model fit, and fit of internal structure of model.

The data results are organized in **Table 1**. Preliminary fit criteria, fit of internal structure of model, and overall model fit are explained as following.

From **Table 1**, the dimensions of Computer multimedia teaching (Law of effect, Law of continuity, Law of practice) could significantly explain Computer multimedia teaching ($t>1.96$, $p<0.05$), two dimensions of learning satisfaction (teachers' teaching and curriculum & environment) could remarkably explain learning satisfaction ($t>1.96$, $p<0.05$), and the explanation of learning outcome reaches the significance ($t>1.96$, $p<0.05$). Apparently, the overall model presents favorable preliminary fit criteria.

In regarding to internal structure of model, Computer multimedia teaching shows positive and remarkable correlations with learning satisfaction (0.863, $p<0.01$), Computer multimedia teaching reveals positive and notable correlations with learning outcome (0.849, $p<0.01$), and learning satisfaction appears positive and significant correlations with learning outcome (0.827, $p<0.01$) that H1, H2, and H3 are supported.

The overall model fit standards $\chi 2/Df=1.177$, smaller than the standard 3, and RMR=0.007 reveal that the results of $\chi 2/DF$ and RMR are appropriate. Besides, chi-square is sensitive to sample size that it is not suitable for directly judging the fit. However, the overall model fit standards GFI=0.982 and AGFI=0.927 are higher than the standard 0.9 (the closer GFI and AGFI to 1 showing the better model fit) that this model presents better goodness-of-fit indicators.

## CONCLUSION

The research results show that current computer multimedia teaching presents the advantage of situation creation and the characteristics of interface visualization and element reusability. Teaching designers could flexibly apply technology to present teaching strategies. Applying computer multimedia teaching to automobile education could research & develop and design teaching materials in the media production, including point organization, pictures, photos, close-up pictures, continuous replay, subtitles, slow motion, distance switch, color effect, dynamic effect, sound effect, fast turning effect, and background music. Besides, the assistance of pictures and photos could specify lecturing contents that static pictures or photos could be timely added in dynamic audio teaching materials, e.g. relevant photos provided by teachers. Network data provided in computer multimedia teaching are presented with objects and combined with image metaphors to thorough utilize scenario memory in the space and provide external resources for students' further learning. It could also provide texts or categories for search. When matching with processes, students could better know what data to read in which step. It is better to switch scenario so that students feel to enter different levels, without wasting time on data irrelevant to tasks, and to relatively enhance student satisfaction and learning outcome.

## RECOMMENDATIONS

Aiming at the research results and findings, the following practical suggestions are proposed in this study.

1. As the large effect of the interface design refinement of virtual reality materials on learning outcome, detailed revisions and suggestions could be acquired after several times of user tests to gradually refine the interface design and interaction operation. For instance, the automobile vocational education courses are detailed, huge, and complicated that the information transmission and interaction should be carefully planned the information presentation and students' participation feedback. Various angles could be applied to the switch of close up and distance switch to provide students' with clear ideas for the overall allocation and local pictures in automobile service processes. Perhaps the production different from general teaching could be applied to present with vivid and active methods so as to induce students' learning interests.
2. From the aspect of enhancing students' learning satisfaction, teachers' course contents and professionalism are the key factors. In this case, teachers integrating virtual reality technology and changes into course design and present diversified teaching methods could assist in enhancing students' learning intention and further promote the learning outcome.
3. In addition to Tian Sino-German University of applied Science, the higher vocational colleges in China still stay at college-level education. In face of the society with rapidly developed technology, college-level education could hardly conform to the skill requirements of industries for talents. Properly opening some departments for university-level education could enhance the technical profession of vocational graduates. Besides, industry-university cooperation for students' internship or the opening of industry-university cooperation classes could conform to the requirements of local industries and allow students studying for the purpose of application to engage in relevant industries after the graduation.

## REFERENCES

Ab Aziz, K., & Siang, T. G. (2014). Virtual reality and augmented reality combination as a holistic applications for heritage preservation in the UNESCO World Heritage Site of Melaka. *International Journal of Social Science and Humanity, 4*(5), 333. https://doi.org/10.7763/IJSSH.2014.V4.374

Ali, N., Ullah, S., Alam, A., & Rafique, J. (2014). 3D Interactive Virtual Chemistry Laboratory for Simulation of High School Experiments. *Proceedings of EURASIA GRAPHICS 2014*, Paper, 12.

Bhagat, K. K., Liou, W. K., & Chang, C. Y. (2016). A cost-effective interactive 3D virtual reality system applied to military live firing training, Virtual Reality. Retrieved from https://www.researchgate.net/publication/299998781_A_cost-effective_interactive_3D_virtual_reality_system_applied_to_military_live_firing_training

Daggubati, L. S. (2016). Effect of cooperation on players' immersion and enjoyment. Missouri, USA: *Missouri University of Science and Technology*.

Freina, L., & Ott, M. (2015). A literature review on immersive virtual reality in education: state of the art and perspectives. In *The International Scientific Conference eLearning and Software for Education* (Vol. 1, p. 133)." Carol I" National Defence University.

Griffin, T., Giberson, J., Lee, S. H. M., Guttentag, D., Kandaurova, M., Sergueeva, K., & Dimanche, F. (2017). Virtual Reality and Implications for Destination Marketing. *Tourism Travel and Research Association Conference*.

Huang, H. M., Liaw, S. S., & Lai, C. M. (2016). Exploring learner acceptance of the use of virtual reality in medical education: a case study of desktop and projection-based display systems. *Interactive Learning Environments, 24*(1), 3-19. https://doi.org/10.1080/10494820.2013.817436

Juan, Y. K., & Chao, T. W. (2015). Game-based learning for green building education. *Sustainability, 7*(5), 5592-5608. https://doi.org/10.3390/su7055592

Jung, T., & Han, D. (2014). Augmented Reality (AR) in Urban Heritage Tourism. *eReview of Tourism Research, 5*, 1-5.

Kim, Y., Son, Y., & Han, S. (2016). What is the Role of TV Commercials in the Trans-Media Era? *Indian Journal of Science and Technology, 9*(41), 1-10. https://doi.org/10.17485/ijst/2016/v9i41/103846

Kourouthanassis, P., Boletsis, C., Bardaki, C., & Chasanidou, D. (2015). Tourists responses to mobile augmented reality travel guides: The role of emotions on adoption behavior. Pervasive and Mobile Computing, 18, 71-87. https://doi.org/10.1016/j.pmcj.2014.08.009

Kuksa, I., & Childs, M., (2014). *Making Sense of Space the design and experience of virtual spaces as a tool to communicate*. Cambridge: Chados Publishing, 1-21.

Lan, Y. J. (2014). Does Second Life improve Mandarin learning by overseas Chinese students? *Language Learning & Technology, 18*(2), 36-56.

Lan, Y. J. (2015). Contextual EFL learning in a 3D virtual environment. *Language Learning & Technology, 19*(2), 16-31.

Lan, Y. J., Chen, N. S., Li, P., & Grant, S. (2015). Embodied cognition and language learning in virtual environments. *Educational Technology Research & Development, 63*(5), 639-644. https://doi.org/10.1007/s11423-015-9401-x

Lan, Y. J., Fang, S. Y., Legault, J., & Li, P. (2015). Second language acquisition of Mandarin Chinese vocabulary: Context of learning effects. *Educational Technology Research & Development*. https://doi.org/10.1007/s11423-015-9380-y

Lan, Y. J., Kan, Y. H., Sung, Y. T., & Chang, K. E. (2016). Oral-performance language tasks for CSL beginners in Second Life. *Language Learning & Technology, 20*(3).

Lan, Y. J., Sung, Y. T., Cheng, C. C., & Chang, K. E. (2015). Computer supported cooperative prewriting for enhancing young EFL learners' writing performance. *Language Learning & Technology, 19*(2), 134–155.

Martins, C., Oliveira, T., & Popovič, A. (2014). Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk applications. *International Journal of Information Management, 34*(1), 1-13. https://doi.org/10.1016/j.ijinfomgt.2013.06.002

Maruping, L. M., Bala, H., Venkatesh, V., & Brown, S. A. (2017).Going beyond intention: Integrating behavioral expectation into the unified theory of acceptance and use of technology. *Journal of the Association for Information Science and Technology, 68*(3), 623-637. https://doi.org/10.1002/asi.23699

Mütterlein, J., & Hess, T. (2017). Immersion, Presence, Interactivity: Towards a Joint Understanding of Factors Influencing Virtual Reality Acceptance and Use. In *23rd Americas Conference on Information Systems (AMCIS)*, Boston, MA.

Nawaz, A., Skjæret, N., Ystmark, K., Helbostad, J. L., Vereijken, B., & Svanæs, D. (2014). Assessing seniors' user experience (UX) of exergames for balance training. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (pp. 578-587). ACM. https://doi.org/10.1145/2639189.2639235

Ratna, P. A., & Mehra, S. (2015). Exploring the acceptance for e–learning using technology acceptance model among university students in India. *International Journal of Process Management and Benchmarking, 5*(2), 194-210. https://doi.org/10.1504/IJPMB.2015.068667

Ryan, M. L. (2015). Narrative as virtual reality 2: Revisiting immersion and interactivity in literature and electronic media. *JHU Press*.

Schuster, K., Hoffmann, M., Bach, U., Richert, A., & Jeschke, S. (2014). Diving in? how users experience virtual environments using the virtual theatre. In *International Conference of Design, User Experience, and Usability* (pp. 636-646). Springer International Publishing. https://doi.org/10.1007/978-3-319-07626-3_60

Shafer, D. M., Carbonara, C. P., & Popova, L. (2014). Controller required? The impact of natural mapping on interactivity, realism, presence, and enjoyment in motion-based video games. *Presence, 23*(3), 267-286. https://doi.org/10.1162/PRES_a_00193

Shen, C. W., Ho, J. T., Kuo, T. C., & Luong, T. H. (2017). Behavioral Intention of Using Virtual Reality in Learning. In *Proceedings of the 26th International Conference on World Wide Web Companion* (pp. 129-137). International World Wide Web Conferences Steering Committee. https://doi.org/10.1145/3041021.3054152

Shi, Y. (2017). *Should Organizations Leverage 360-degree Commercial Video Campaigns?: The influence on customer-brand engagement and customer-based brand equity* (Master's thesis), University of Twente.

Wamba, S. F., Bhattacharya, M., Trinchera, L., & Ngai, E. W. (2017). Role of intrinsic and extrinsic factors in user social media acceptance within workspace: Assessing unobserved heterogeneity. *International Journal of Information Management, 37*(2), 1-13. https://doi.org/10.1016/j.ijinfomgt.2016.11.004

Wei, H. C., Peng, H., & Chou, C. (2015). Can more interactivity improve learning achievement in an online course? Effects of college students' perception and actual use of a course-management system on their learning achievement. *Computers & Education, 83*, 10-21. https://doi.org/10.1016/j.compedu.2014.12.013

Wijnants, M., Van Erum, K., Quax, P., & Lamotte, W. (2015).Web-mediated Augmentation and Interactivity Enhancement of Omni-directional Video in Both 2D and 3D. In *Proceedings of the 11th International Conference on Web Information Systems and Technologies*, 21-34. https://doi.org/10.5220/0005442900210034